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Original
Building Links between Europe and South-East Asia in the Field of EGNSS: the BELS Project and the NAVIS Centre / Povero, G., Deisting, B., Kling, S., Tung, T.H., Vinh, L.T., Belforte, G., Subirana, J.S., Rizos, C., Marradi, L.. - ELETTRONICO. - (2015). (21st Ka and Broadband Communications Conference Bologna, Italy 12-14 Ottobre 2015) [10.13140/RG.2.1.3311.4320].

Availability:
This version is available at: 11583/2628194 since: 2016-01-14T15:35:20Z

Publisher:

Published
DOI:10.13140/RG.2.1.3311.4320

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21 November 2026

BUILDING LINKS BETWEEN EUROPE AND SOUTH-EAST ASIA IN THE FIELD OF EGNSS: THE BELS PROJECT AND THE NAVIS CENTRE

Gabriella Povero
Istituto Superiore Mario Boella, via Boggio 61, Torino, Italy;
Tel. +39 011 2276 419 – Fax. +39 011 2276 299 – email: povero@ismb.it
Baerbel Deisting
bavAIRia e.V., Friedrichshafener Str. 1, 82205 Gilching, Germany,
Tel. +49 8105 27292741, Fax. 49 8105 2729 2715, e-mail: deisting@bavAIRia.net
Sabine Kling
bavAIRia e.V., Friedrichshafener Str. 1, 82205 Gilching, Germany,
Tel. +49 8105 27292746, Fax. 49 8105 2729 2715, e-mail: kling@bavAIRia.net
Ta Hai Tung
NAVIS Centre, 1 Dai Co Viet, Hanoi, Vietnam,
Tel. +84 436231673 – Fax. +84 436231672 – email : tung.tahai@hust.edu.vn
La The Vinh
NAVIS Centre, 1 Dai Co Viet, Hanoi, Vietnam,
Tel. +84 436231673 – Fax. +84 436231672 – email : vinh.lathe@hust.edu.vn
Gustavo Belforte
Politecnico di Torino, corso Duca degli Abruzzi 24, Torino, Italy
Tel. +39 011 0907 078, Fax. +39 011 090 7099, email: gustavo.belforte@polito.it
Jaume Sanz Subirana
Universitat Politecnica de Catalunya, Calle Jordi Girona 31, Barcelona, Spain,
Tel. +34934016030, Fax. +34934015981, email: jaume.sanz@upc.edu
Chris Rizos
School of Civil & Environmental Engineering, UNSW, Sydney, NSW 2052, Australia
Tel. +61293854205, email: c.rizos@unsw.edu.au
Livio Marradi
Thales Alenia Space Italia S.p.A., Via E. Mattei, 120064 Gorgonzola (MI), Italy
Tel. +390225075361, Fax. +39 02 25075435 e-mail:livio.marradi@thalesaleniaspace.com

Abstract

South East Asia is growing at an impressive pace with its GDP having increased by about 350% in ten years, rising from 650 Billion $ in 2002 to about 2300 Billion $ in 2012. Regional governments actively promote infrastructure, logistics and service development to create a favourable environment for sustainable growth. Within this framework, GNSS applications play a vital role. In particular, the increasing demand for better services, in both the public and private sector, and logistics is going to require increasingly reliable and trusted GNSS applications. South East Asia has the highest multi-GNSS coverage in the world, and is therefore the ideal place to test and compare performance and opportunities offered by the different global navigation satellite systems. On the one hand, an active promotion of EU GNSS (EGNSS) technology in this region, rising awareness on its main features while on the other hand facilitating the linking of European enterprises with South East Asian GNSS stakeholders, are extremely important so as to establish and maintain global European scientific and industrial leadership in this crucial sector. Indeed, it is also fundamental to encourage the penetration of EGNSS industry into the South East Asian market taking into account all potential applications of EGNSS. Therefore, the BELS project exploits the opportunities presented by the NAVIS Centre, an International Collaboration Centre for Research and Development on Satellite Navigation Technology in South East Asia based in Hanoi, Vietnam, to promote visibility and to raise awareness of EGNSS technology in the region. The next three years will be crucial for paving the way for Galileo services, both for European companies that can enter a new growing market and for the South East Asian countries that can discover the capabilities of the EGNSS technology. Consequently, BELS facilitates and supports

the visits of European companies for such purposes as carrying out tests in the NAVIS Centre and hence to assist them in getting ready for the global GNSS applications market.

1. Introduction

This paper describes the opportunities offered by the project BELS (Building European Links toward South East Asia in the field of EGNSS) to companies, institutions, researchers from Europe and South East Asia (SEA) working in the field of GNSS. The project, funded by the European GNSS Agency (GSA) under the European Union's Horizon 2020 – the EU Framework Programme for Research and Innovation, under grant agreement no 636853 – has been conceived to favour the establishment and strengthening of collaborations between European and South East Asian institutions, to facilitate the testing of European GNSS solutions in the South East Asian environment, and to foster the mobility of students and researchers in the field of GNSS between the two regions.

The role of SEA in GNSS is analysed and the reasons for its importance are highlighted in Section 2. Section 3 is focused on NAVIS Centre, the International Collaboration Centre for Research and Development on Satellite Navigation Technology in South East Asia based in Hanoi, Vietnam, while in Section 4 the BELS project and its objectives are described. Section 5 details the activities which will be conducted during the BELS project lifespan, while future perspectives and expected outcomes are presented in Section 6.

2. Reasons for going to South East Asia

According to [1], SEA is a fast changing region where countries are experiencing different levels of development and have very diverse outlooks. What is evident in all SEA countries is their fast development. The SEA nations have a growing population of more than 600 million people, rather young in average age, and quite keen to use and exploit the latest ICT technologies. Global Navigation Satellite Systems (GNSS) technologies are a key component of ICT equipment such as mobile devices, which according to [2] are "the most popular platform to access Location-based Services, followed by devices used for road applications". The GSA Market Report [2] highlighted that the primary region of global market growth of GNSS devices is the Asia Pacific region. Moreover, GNSS-based applications and services are very important in many fields, and in particular in the transportation sector. In fact, a constantly increasing demand for better services and logistics in the SEA region is going to require more and more solutions that make use of GNSS.

In addition, the SEA region has the highest multi-GNSS coverage and is therefore the ideal place to compare and test performance and opportunities offered by the different global navigation satellite systems. An active promotion of EGNSS technology, rising awareness of its main features, meanwhile facilitating the linking of European companies with South East Asian GNSS stakeholders will contribute to global European leadership in this emerging sector. Support of European GNSS industry to enter the South East Asian market should be one of the key European GNSS policies. For example, GNSS is an enabling technology for the smart city, and a recent study from Navigant Research [3] states that "cumulative investment in smart city technology in Asia Pacific will total $63.4 billion during the period from 2014 to 2023".

In addition, it has to be noted that important ionospheric scintillation phenomena, affecting GNSS signals and services, take place in sub-tropical regions and can be observed in SEA. Mitigation of the consequences of scintillation is crucial for ensuring the development of better equipment and services, that are also key factors for gaining larger market share in this part of the world.

3. The NAVIS Centre

The NAVIS Centre [4], based in the Hanoi University of Science and Technology (HUST), was established in the framework of EU-funded projects to act as linking entity between Europe and SEA in the field of GNSS. Its objectives are to promote EGNSS technology, and thus reinforcing cross-links between EU and SEA stakeholders, and to facilitate international collaboration among players. To fulfil its mission the NAVIS Centre focuses its activities on technology transfer, education and training, research and development, awareness raising, and support to public bodies. The NAVIS Centre has an international governing body, with members from Vietnam,

Europe and Australia, and its Executive Committee consists of one European and one Vietnamese co-director so as to ensure its multi-national nature. The NAVIS Centre is conducting research on various topics, such as software defined radio multi-GNSS receivers, techniques for precise positioning, low-latitude ionospheric monitoring, and others. In addition it is actively contributing to GNSS applications for ITS, and in so doing is tackling one of the most important problems in SEA, where highly congested traffic often impacts on citizens' everyday life. In the last few years the NAVIS Centre has been collaborating with important key players in the field of GNSS from both European and Asia Pacific regions, such as the European Commission's Joint Research Centre, the European GNSS Agency (GSA), the Japan Aerospace Exploration Agency (JAXA), and others. Most researchers and engineers within the NAVIS team hold a PhD obtained from a European university, which makes them ready to work in an international environment. Although the Centre's activities started less than five years ago, the Centre now has a high national and international reputation. Its excellent work and expertise has been demonstrated by the certification received by the European Space Agency in 2013 as one of the first fifty institutions in the world which acquired position fixes using solely Galileo satellites. this achievement by the NAVIS Centre was unique in SEA.

4. The BELS Project

The BELS Project consolidates a series of actions started by some of the authors in 2004. The collaboration between Vietnam and Europe on satellite navigation and positioning commenced with a project named JEAGAL, funded by the Asia IT&C line of the European Commission, a train-the-trainer action to prepare Chinese and Vietnamese future researchers on Galileo-related topics. The present Director of the NAVIS Centre was actually one of the Vietnamese students who benefitted from this project's activities, since he had the possibility to attend the Specialising Master on Navigation and Related Applications held in Italy by Politecnico di Torino [5].

More recently, the SEAGAL Project, answering an FP7 call which specifically sought the establishment of Collaboration Centres on European GNSS around the world, spurred the setup of the NAVIS Centre. The Centre was opened on 1st October 2010 in Hanoi, Vietnam, and it started operations in late 2011. SEAGAL was followed by a second project, Growing NAVIS, whose main objective was to support the growth of the NAVIS Centre, enhancing its technical capabilities and strengthening its cooperation with Europe, while starting a fruitful cooperation with several important stakeholders in the region. It is important to underline the fact that the establishment of the NAVIS Centre aims to fulfil the guidelines of the Co-Chair's Statement of the 18th ASEAN-EU Ministerial Meeting - Madrid, 26 May 2010 - that reports "51. The Ministers welcomed the setting-up of a co-operation framework in the field of civilian use of satellite navigation systems, and expressed their willingness to promote the involvement of their relevant institutions and organizations. They encouraged in particular the establishment of a permanent EU-ASEAN collaboration centre on civilian use of satellite navigation systems."

While the NAVIS Centre has been set up and is evolving, the European Union has been developing and deploying its GNSS, Galileo, as shown in Figure 1. Indeed, the activities of the BELS Project are occurring during the Galileo deployment phase, and as the system has entered its Initial Operational Capability (IOC) testing of its performance in both Europe and Asia has commenced.

The BELS Project [6] aims to facilitate the breakthrough of EGNSS technology, with a particular focus on SEA, through a variety of coordinated activities in support of industrial partnership, awareness raising and capacity building. The BELS consortium gathers European and South East Asian institutions, namely Istituto Superiore Mario Boella, Politecnico di Torino, Universitat Politecnica de Catalunya, bavAIRia E.V., Ecole Nationale de l'Aviation Civile, NAVIS Centre, Thailand National Science and Technology Development Agency, University of New South Wales, IfEN Gesellschaft fur Satellitennavigation MBH, Thales Alenia Space Italia S.p.A., Indra Systemas S.A., Septentrio N.V. Leveraging the facilities of the NAVIS Centre in Hanoi, which is a strategic asset for Europe, and other partners in SEA, this project aims to enhance the presence of EGNSS technology and of European enterprises in the SEA region. At the same time it plans to organise events and meetings to raise the awareness of European initiatives in the field of GNSS among stakeholders of the ASEAN Member States. BELS also offers opportunities to SEA young researchers and engineers, so as to pave the way for a closer cooperation between Europe and South East Asia, and in so doing will increase the benefits that satellite navigation, and the Galileo system in particular, can offer to SEA citizens.

5. BELS Activities

BELS activities, whose overall concept is illustrated in Figure 2, are organised around three pillars:

A. Promotion of EGNSS Solutions in SEA – On the one hand, the NAVIS Centre will be the base for European companies and institutions to test their solutions, thus helping them to be ready for the global market. This opportunity will be exploited by some of the companies which are members of the consortium, but an opportunity will also be offered to companies outside the consortium. Workshops to advertise this opportunity will be organised in Europe, and specific calls will be issued to select the most interested in this initiative. On the other hand, a competition will be launched to identify the most promising ideas on the use of EGNSS in SEA, and to attract smart researchers/entrepreneurs from ASEAN Member States to develop EGNSS-based business ideas and applications.

B. Awareness on EGNSS in SEA – The BELS Project will encourage cooperation between important GNSS stakeholders active in SEA so as to promote EGNSS solutions. In particular, the project will co-organise the annual event promoted by the Multi-GNSS Asia organisation [7], bringing to the region some of the most innovative solutions in GNSS technology and applications developed in Europe. Furthermore, short events will be held in each of the ASEAN Member States to address also those countries where little has been done in past years to make local authorities aware of European technological solutions in satellite navigation.

C. Capacity Building on EGNSS in SEA – These activities are mainly oriented to training in Europe of South East Asian researchers and engineers, so as to introduce a new generation of experts to European technology and culture. Grants for internship periods in European companies, support for joint PhD programmes, and supporting research periods in European institutions, are among the activities that will be facilitated by the BELS Project partners.

Among the activities for the promotion of EGNSS Solutions in SEA, European companies have the possibility to test their solutions in the NAVIS Centre. Thales Alenia Space will carry out tests with its GISMO (GNSS Ionospheric Sensor Monitor) receiver. It is newly designed GNSS receiver that satisfies the specific task of Ionosphere Scintillation Monitoring. It produces accurate "ionospheric channel" estimations based on the demodulated GNSS Signal-in-Space. One of the new features introduced in the GISMO system is the autonomous and real-time detection of scintillation events.

GISMO is a GPS/Galileo/SBAS dual-frequency receiver with configurability in terms of band selection between L1/E1, L2, E5a, E5b. The receiver can make raw measurements. Signal-to-noise ratio and carrier phase measurements can be made at configurable rates of 1Hz, 20Hz or 50Hz. These data are available to the user to analyse scintillation events in post-processing mode. Additionally, specific ionospheric products are estimated. Due to the experimental nature of the measurements, the receiver provides high configurability of its inner working parameters. The high stability and accuracy of the carrier phase observables are obtained with the aid of a high stability low phase noise 10MHz OCXO. An innovative robust carrier phase tracking method based on a Kalman Filter PLL is being developed and tested by Thales Alenia Space. GISMO also monitors different aspects of the surrounding environment as it provides information such as: Multipath Indicator, Interference Indicator, Code Minus Carrier Iono Free quantity, and Cycle Slips indicators for all the processed signals.

In the framework of the BELS Project a GISMO receiver will be installed at the NAVIS Centre in Hanoi to perform long-term multi-GNSS experiments in the SEA region. With the collaboration of the NAVIS Centre, the GISMO experiment will include collection and analysis of data sets to assess acquisition and tracking performance and robustness, navigation solution performance, and scintillation environment monitoring.

6. Future Perspectives

The BELS Project will run while the Galileo system is being fully deployed. This will help in building interest and momentum for its activities among not only GNSS companies and experts, but also local and regional authorities. The Project will pave the way for future cooperation between European and SEA stakeholders, and will contribute to identifying the next steps necessary to convert the “European Links toward South East Asia in the field of EGNSS” into a sustainable connection.

7. References

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FIGURES

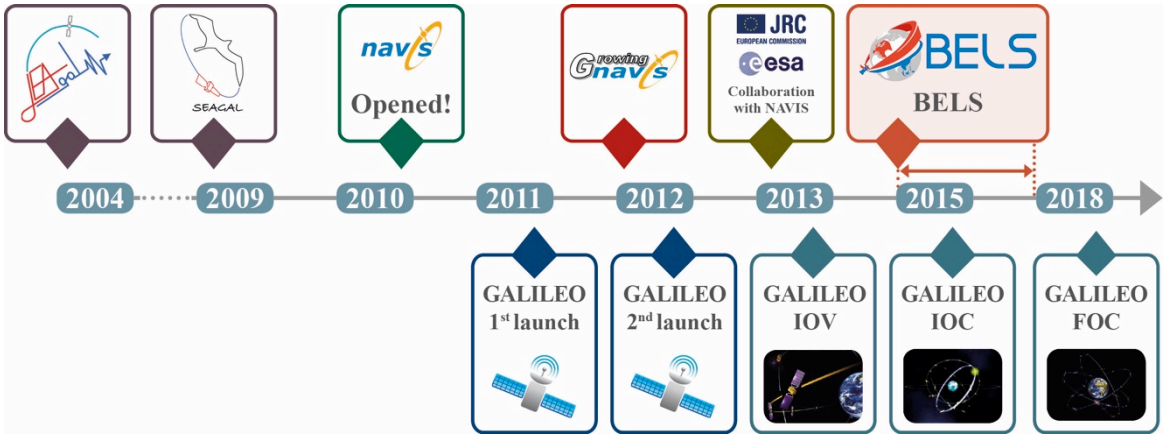


Figure 1: Development of the cooperation with South East Asia compared to the Galileo Programme development

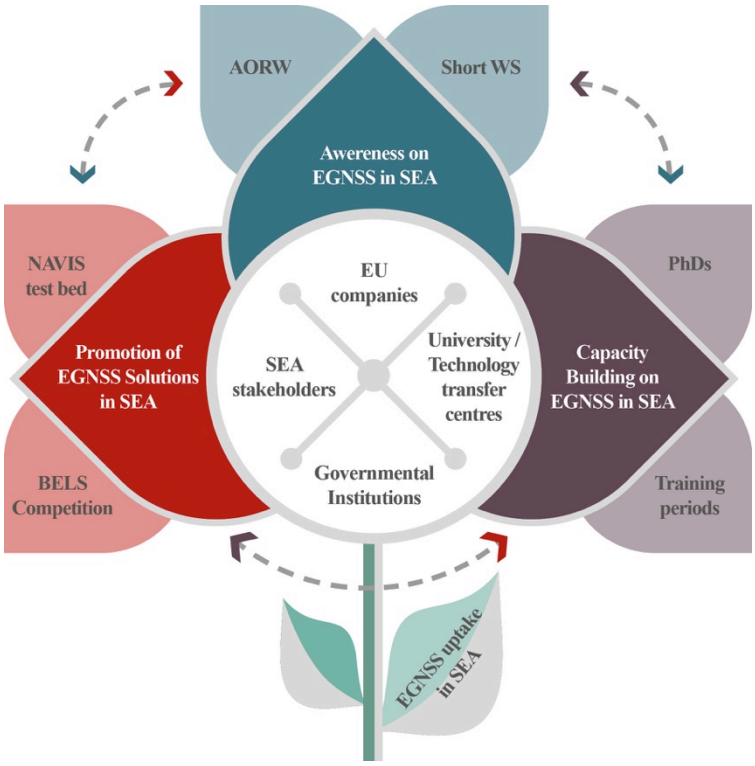


Figure 2: The overall BELS concept